ENERGY CONSERVATION THROUGH MECHANICAL DEHUMIDIFICATION MIRAMICHI VALLEY HIGH SCHOOL POOL NEWCASTLE, N.B.

February, 1985

CREDA PROJECT # 2055

Prepared by:

Enerplan Consultants Ltd.

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

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Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

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1.0 Executive Summary

A detailed analysis of the results of the energy project on the Miramichi Valley High School swimming pool reveals that the energy refit was a success. The dehumidifying heat pump heats the pool water as well as controlling humidity and temperature at a constant level. This has proved very energy efficient. The economic feasibility is dependent on the hours of usage and the number of users. The simple payback for this pool retrofit is four and a half years, although this would not be the same for every indoor pool, as one would have to be studied individually to determine the economic feasibility.

The application of high pressure sodium and metal halide lighting over the pool area has been well accepted and has been very successful in producing low energy costs.

1.0 SOMMAIRE-RECOMMANDATION

Une analyse détaillée des résultats du projet énergétique de la piscine de la Regional High School de la vallée de la Miramichi révèle que le rattrapage énergétique a été un succès. C'est la déshumidification produite par la pompe à chaleur qui permet de réchauffer l'eau de la piscine tout en maintenant l'humidité et la température à un degré constant. Il s'agit d'une installation très efficace. La faisabilité économique dépend cependant du nombre d'heures d'utilisation et du nombre d'usagers de la piscine. Le recouvrement de ce rattrapage est de quatre ans et demi; cependant, il n'en serait pas de même pour toutes les piscines intérieures dont la faisabilité économique des travaux nécessiterait une étude individuelle.

Le remplacement du système d'éclairage existant par des appareils comprenant un mélange de sodium à haute pression et d'halogénure métallique a permis de réduire les coûts de l'éclairage.

2.0 Introduction

2.1 General

In the province of New Brunswick there are 68 high schools of which 6 have indoor swimming pools. The cost of operating an indoor pool is steadily increasing due to the increasing energy costs and the large energy consumption of these facilities.

Enerplan Consultants Ltd. prepared and submitted a proposal for an energy demonstration project on a typical indoor pool in the Miramichi Valley High School on behalf of the Department of Education. This proposal was submitted in December 1981 and accepted by the Energy Secretariat for funding under the Conservation and Renewable Energy Demonstration Agreement in February 1983. The primary objective of the proposal was to demonstrate feasible methods of reducing operating costs of indoor swimming pools. By installing energy efficient equipment with a short payback period and considerable energy savings, this was achieved with a four and one half year payback with the new system being 59% more efficient than the old.

2.2 Site Selection

With six high schools that have indoor swimming pools to choose from, the selection was based on some general ideas in order to find a good demonstration project. The criteria used for selection are listed below:

(1) geographical location
(2) population of the school
(3) type of fuel consumption
(4) existing indoor swimming pool
(5) funding available from school district

The site selected, Miramichi Valley High School, Northumberland County, is a good representative of a typical high school indoor pool. The school is located in Newcastle and has an enrollment of approximately 1,005 students. The pool is used on the average of 14 1/4 hours per day by approximately 68,000 people each year.

3.0 Technical Description

3.1 General

The energy consumption in the Miramichi Valley High School swimming pool can be divided into three items:

1. Lighting
2. Heating pool area
3. Heating pool water

The demonstration project is aimed at these items and determines the economic feasibility of each for a retrofit.

Upon completion of an Energy Audit during 1981, it was concluded that demonstrations in heat reclaim by dehumidification and new lighting would provide the best energy savings.

3.2 Heat Reclaim by Dehumidification

The heating systems for the pool and pool area before the retrofit consisted of an electric water heater and associated pumps, fans, heating coils, controls, dampers, etc. The swimming pool loses heat in three ways: evaporation of water from the pool, conduction from water to air, and conduction from water to the pool walls. The last two are very minor compared to the first. Previously, to heat and control the humidity of the pool area, a mixed air system was used. Any outside air brought in to control humidity would have to be preheated if it was at a temperature lower than 80°F. The air that was blown thru the heating coil was also used to make up for heat losses through the building skin.

3.2 Heat Reclaim by Dehumidification (cont'd)

The heat loss from pool water to air due to evaporation can be reclaimed by drying the air. This is done by passing the air through a dehumidifier coil. Here the air is cooled below its dew point and the water condensed. The heat reclaimed is absorbed by a mechanical refrigeration system and is used to reheat the pool water. The heat remaining in the refrigeration unit is used in the reheat coil to warm the air which has been cooled in the dehumidifier coil and to offset pool enclosure conduction losses. Schematics of dehumidification systems before and after retrofit with a detailed description of how the new system works are provided in Appendix A.

3.3 Lighting

The pool area requires considerable lighting due to the size of the room and the activities carried out in it. The lighting used before the retrofit was mercury vapour type.

Recent advances in lighting technology have produced more efficient lighting. The mercury lighting was replaced with a mixture of high-pressure sodium and metal halide fixtures to improve the energy efficiency. The twin 400 watt mercury vapor lamps have been replaced with alternating rows of 400 watt metal halide and 250 watt high pressure sodium.

The efficiencies of these and other light sources available are illustrated in Appendix B.

4.0 Performance of System

4.1 Metering & Monitoring

The Miramichi Valley High School swimming pool energy use was calculated before the retrofit using information supplied by pool operating staff. The system was then monitored extensively after the retrofit. The energy consumption of the pool was metered to determine the amount of energy consumed by the following items:

(a) heat pump
(b) electric water heater
(c) lighting

Meters were also installed to record:

(a) make up water
(b) pump run time
(c) heat pump and dehumidifier unit run time
(d) temperature of water
(e) temperature of air

The data was recorded by operating personnel at the pool on every working day. These readings were forwarded to Enerplan Consultants every week for continual monitoring of the system.

A sample of the data sheet used by the operators, a schematic of the monitoring system and a performance monitoring plan can be found in Appendix C.

4.2 Technical Performance

4.2.1 General

The energy demonstration systems installed in the pool area have performed well over the 1983-84 season. They have been received by the users of the facilities and have accomplished their expected tasks.

4.2.2 Lighting System

The lighting system has performed well and has been well received by the users of the facility. The mixture of the colors of the two different lamps has posed no problems and provides for different types of lighting for the various events that take place at the pool.

4.2.3 Heat Pump and Dehumidifier Unit

The Dry-o-tron unit has proved very successful and provides enough heat from the hot humid air to keep the pool at 82°F. The unit keeps the humidity at 50% which is the required level and the water that is condensed out of the air is recycled back into the pool. This system has proved very energy efficient and virtually maintenance-free.

4.2.4 Electric Water Heater

The electric water heater, being the original pool heater was left as a back-up system for the Dry-o-tron. After the retrofit was completed it was found that, once the pool was at the desired temperature, and the Dry-o-tron in full working order, the water heater was not needed. However, the heater was left as a back-up system.

5.0 Cost Benefit Analysis

5.1 Payback Periods

A payback period is calculated by dividing the estimated capital costs by the estimated annual savings.

Example

Modification "A" is estimated to cost $20,000 to install and will save 150,000 KWH annually.
Payback period =
$20,000/150,000 KWH x $.05/Kw = 2.67 years

This calculation method is used commonly by business as an easy reference for economic feasibility. It does not consider interest rates or increasing costs of energy.

5.2 Lighting System

5.2.1 General

The cost effectiveness of a new lighting system is dependent on a few variables as listed below:

(a) Hours of usage
(b) Electric Rate Structure
(c) Type of fixtures and their efficiencies

In this case, the pool has a combination of metal halide and high pressure sodium fixtures.

5.2 Lighting System (cont'd)

5.2. Analysis

Operating Season

Summer - 6 a.m. to 9 p.m.
Monday to Friday

1 p.m. to 8:30 p.m.
Saturday and Sunday

Winter - 6 a.m. to 11 p.m.
Monday to Friday

1 p.m. to 8:30 p.m.
Saturday and Sunday

Daily Occupancy - Approximately 190 people

Previous Lighting - 20 mercury vapour fixtures
@ 480 watts each = 9600 watts

New System - 18 High Pressure Sodium Fixtures
@ 310 watts each = 5580 watts and
2 metal halide fixtures
@ 450 watts each = 900 watts
Total = 6480 watts

Cost Benefit Analysis

Capital Cost of the System	=	$7,000
Previous cost Per Year		$2,400
Cost for Year 1983-84	=	$1,600

Note:

Enerplan Consultants does not feel that the facilities are operating under the above schedule. (Total hours = 5700). Actual usage appears to be about 65% of the time based on metering. Based on the operating values after the retrofit, and energy consumption being proportional, it is felt the operating cost prior to retrofit was approximately $2,400, realizing a savings of $800 per year. This giving a simple payback of 8.75 years. Details are provided in Appendix E.

5.3 Heating and Ventilating

5.3.1 General

The cost effectiveness of a heating and dehumidifying system is dependent on many variables. Some of the variables which have impact on this system are as follows:

(a) length of operating season
(b) geographic location of facility
(c) daily occupancy cycle of facility
(d) volume and dimensions of pool
(e) type and size of mechanical unit

5.3.2 Analysis

Operating Season

Summer - 6 a.m. to 9 p.m.
Monday to Friday

1 p.m. to 8:30 p.m.
Saturday and Sunday

Winter - 6 a.m. to 11 p.m.
Monday to Friday

1 p.m. to 8:30 p.m.
Saturday and Sunday

Daily Occupancy - approximately 190 people
Climate Conditions - 8727 degree days
Area of Pool - 3444 ft^2

Cost Benefit Analysis

Capital Cost of Heating & Dehumidifying System = $61,700
Pre-retrofit energy Cost Per Year = $23,000
Post retrofit energy Cost (1983-84 season) = $9,000
Annual Savings = $14,000
Simple Payback Period = 4.4 years
Percentage Savings = 60.1%

5.4 Total

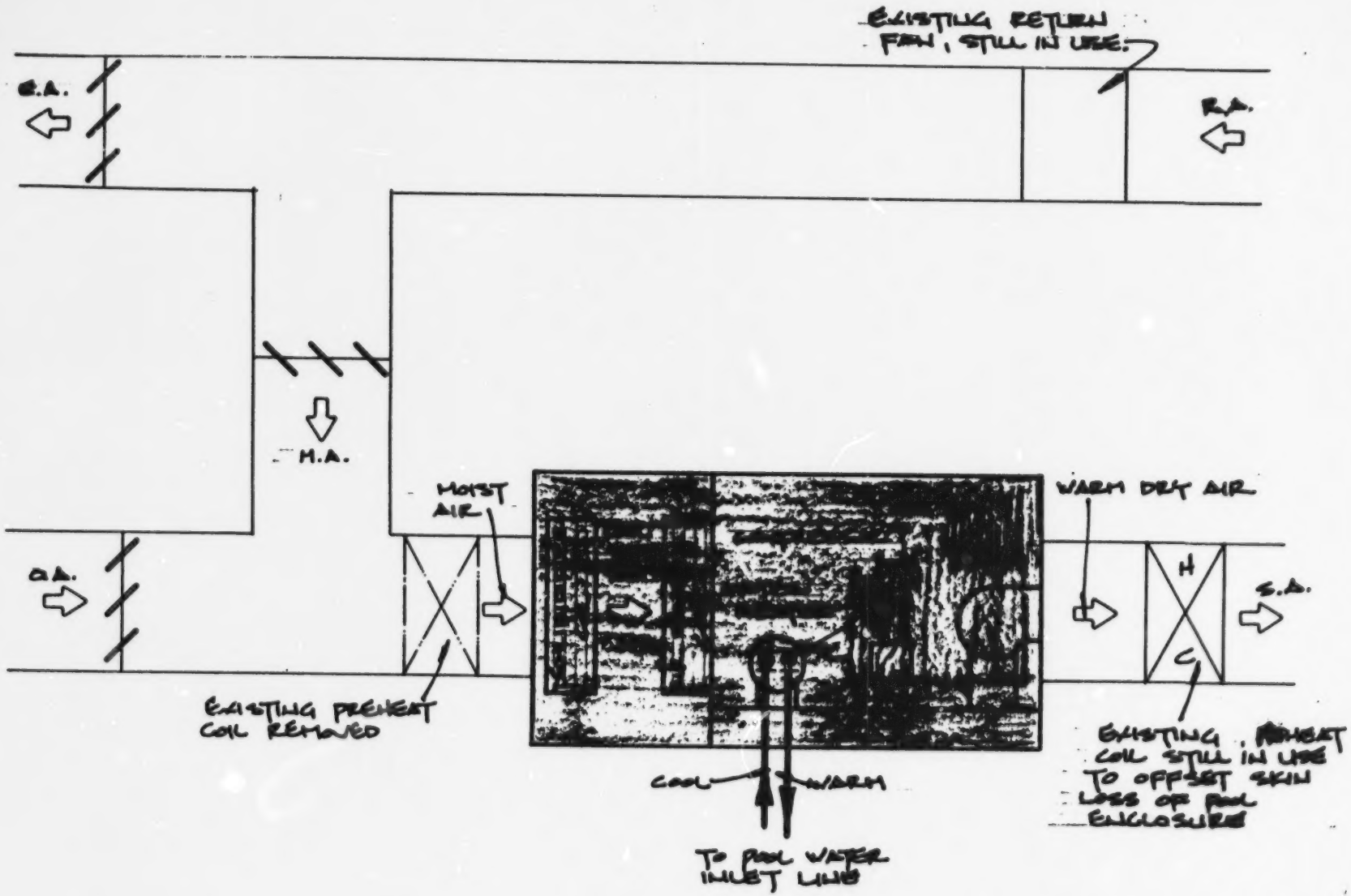
Capital Cost	$67,700.00
Pre-Retrofit Cost Per Year	$25,400.00
Post Retrofit Cost	$10,600.00
Annual Savings	$14,800.00
Simple Payback	4.6 years
Percentage Savings	58.3%

6.0 Conclusions and Recommendations

This project has proved to be very functional, with savings of 60.1 percent on the heating and 33.3 percent on the lighting. For the Miramichi Valley High School, this incurred an annual savings of $21,400. Since there are six schools in New Brunswick with indoor pools, this would give a total savings of about $120,000 each year for the Province of New Brunswick.

APPENDIX "A"

SYSTEM SCHEMATICS



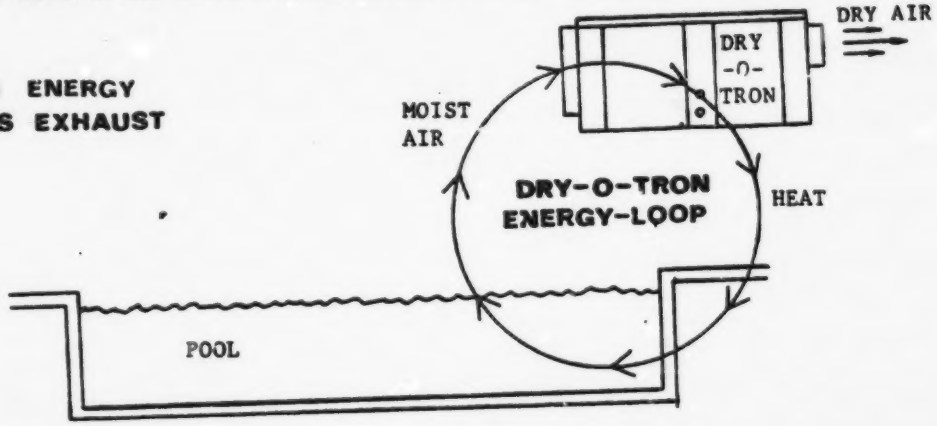
SCHEMATIC OF SYSTEM AFTER RETROFIT

N.T.S.

3. Concept of DRY-O-TRON Heat Pump.

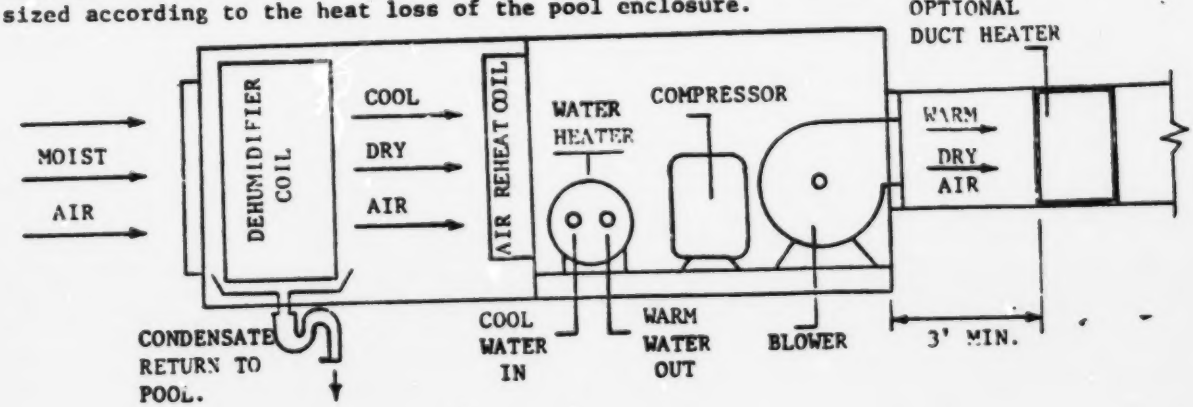
A mechanical refrigeration system is utilized to convert pool water evaporation into condensate and to convert the available latent heat into sensible heat. This sensible heat is then returned to the pool water. The energy cycle of this process has an efficiency of 100% since all latent heat is converted into sensible heat. The electrical energy required to operate this sytem is also converted into sensible heat. No heat other than normal building transmission and outside air infiltration losses have to be replenished.

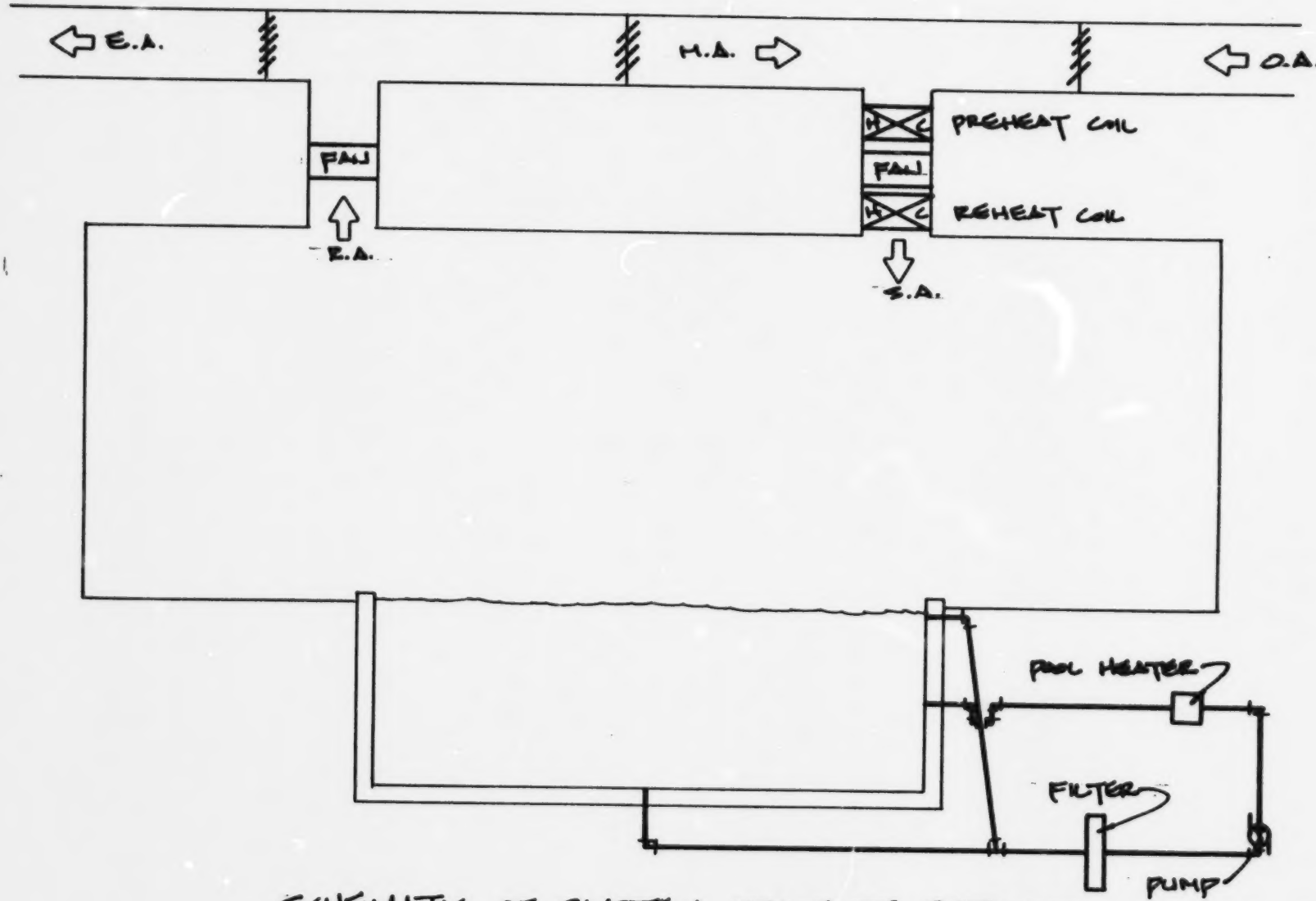
RECYCLES ENERGY
ELIMINATES EXHAUST



4. Principle of DRY-O-TRON Operation:

With the DRY-O-TRON System the moisture laden air from the pool area is drawn through a dehumidifier coil. The air is cooled below its dew point thus condensing air moisture. The heat liberated by this process is absorbed by a mechanical refrigeration system and utilized to maintain the pool water temperature. The heat remaining in the refrigeration cycle is used in the reheat coil to warm the air which has been cooled in the dehumidifier coil. The amount of heat transfered to the water can be adjusted by a manual throttling valve bypassing the water circuit of the heat converter. An optional automatic temperature regulating water valve can by supplied to provide continuous pool water temperature regulation. The throttling valve should be adjusted so that the DRY-O-TRON provides the desired pool water temperature and the remaining excess heat is used for air heating. The condensate may also be returned to the pool, thereby reducing the amount of make-up water. The addition of an optional duct heater completes a total Pool Water Heating, Pool Enclosure Heating and Dehumidification System. The duct heater or alternative air heating system must be sized according to the heat loss of the pool enclosure.





SCHEMATIC OF SYSTEM PRIOR TO RETROFIT

N.T.S.

5.0 DRY-O-TRON SELECTION

The DRY-O-TRON Selection Charts are based on Indoor pools operating within the following standard indoor pool conditions.

Swimming Pools	Whirl Pools
81°F Air temperature	81°F Air temperature
80°F Water temperature	104°F Water temperature
50% Relative humidity	60% Relative humidity
60°F Dew point temperature	65°F Dew point temperature

with no air movement over the water surface.
For pools with other temperature requirements contact factory.

5.1 Rate of Evaporation

The rate of Evaporation depends on the following factors:

1) Water temperature
2) Air temperature
3) Relative humidity
4) Air velocity over water surface
5) Water agitation
6) Splashing, wet floors and wall surfaces

Rate of Evaporation INCREASES when anyone of the following conditions change.

1) Higher water temperature
2) Lower air temperature
3) Lower relative humidity
4) Higher air velocity over water surface
5) High water agitation
6) High water turbulance, wet floors and wall surfaces.

The rate of Evaporation consequently DECREASES when above conditions are reversed.

	RELATIVE HUMIDITY															
AIR TEMP ↓	50%	60%	50%	60%	50%	60%	50%	60%	50%	60%	50%	60%	50%	60%	50%	60%
	EVAPORATION RATE IN LB/SQ.FT FOR PRIVATE POOLS															
92°											.0298	.0215	.0341	.0259	.146	.130
90°									.0281	.0217	.0322	.0258	.0366	.0307	.150	.136
88°							.0254	.0192	.0293	.0231	.0334	.0273	.0377	.0315	.153	.141
86°					.0240	.0181	.0277	.0218	.0315	.0257	.0356	.029	.040	.0341	.156	.146
84°			.0226	.0171	.0261	.0206	.0298	.0243	.0336	.0281	.0377	.032	.041	.0341	.162	.152
82°	.0203	.0161	.0236	.0194	.0271	.0229	.0307	.0265	.0346	.0304	.0387	.035	.043	.0388	.164	.156
80°	.0223	.0183	.0256	.0216	.0290	.0250	.0327	.0287	.0366	.0326	.0406	.037	.045	.0410	.166	.158
WATER TEMP	78°		80°		82°		84°		86°		88°		90°		104° Whirl p.	
Public Pool Correction Factor																

For Semi Private Pools multiply Lb/Sq.Ft. by 1.5 during active pool hours.
For Public pools multiply Lb/Sq.Ft. by 2 during active pool hours.
The above is to obtain maximum evaporation rate.

For other operating conditions consult factory or refer to ASHRAE Application Manual.

8.33 Lbs = one US Gallon
10.00 Lbs = one IMP. Gallon

5.2 Selection Example:

Selection of a DRY-O-TRON unit for a Public Pool with a water surface of 1400 Sq.ft., operating at standard conditions. See paragraph 5.0

Determine Rate of Evaporation

1400 sq. ft. x 0.0245 Lb/hr x 2 = 68.6 Lb/hr = DS 20

As per DS 20 performance curve maximum capacity 70 Lb/hr.

5.3 QUICK SELECTOR CHART

Based on 50% Relative Humidity.

	DRY-O-TRON Model	POOLWATER SURFACE		
		Private Pool	Semi Private	Public
WHIRL POOLS	DS 1	50 Sq.Ft. 4.5m^2	50 Sq.Ft. 4.5m^2	40 Sq.Ft. 3.7m^2
	DS 1.75	80 " 7 m^2	80 " 7 m^2	70 " 6 m^2
SWIMMING POOLS	DS 1.75	290 " 27 m^2	220 " 21 m^2	145 " 14 m^2
	DS 3.5	640 " 60 m^2	480 " 45 m^2	320 " 30 m^2
	DS 5	980 " 91 m^2	735 " 69 m^2	490 " 46 m^2
	DS 7.5	1,430 " 133 m^2	1,075 " 100 m^2	715 " 67 m^2
	DS 12	2,200 " 204 m^2	1,650 " 153 m^2	1,100 " 102 m^2
	DS 20	2,860 " 266 m^2	2,150 " 200 m^2	1,430 " 133 m^2
	DS 25	3,600 " 334 m^2	2,700 " 250 m^2	1,800 " 167 m^2
	DS 35	5,720 " 531 m^2	4,290 " 400 m^2	2,860 " 266 m^2

The use of a Photozone or Bromine water desinfection system is recommended to reduce the corrosive atmosphere to a minimum and to increase swimming comfort.

6. DRY-O-TRON Operating Limitations:

The Standard "DS" DRY-O-TRON Heat pump is designed to work in air temperatures from 100°F (38°C) to 65°F (18°C) and dew point temperatures from 100°F (38°C) to 50°F (10°C). For higher or lower temperature ranges, consult Factory.

8. **Energy Consumption of a Typical DRY-O-TRON System.**

The power consumption of the DRY-O-TRON heat pump is directly related to the Pool water surface area and pool activity since the rate of evaporation governs the energy requirements.

Example:

Indoor Pool Operating Condition:

81°F (27°C)	Air temperature
80°F (26°C)	Pool water temperature
50%	Relative Humidity
60°F (16°C)	Dewpoint Temperature.

Pool Size: 25' x 20' = 500 Sq. Feet

Type of Pool: Private [X] Semi Private [ ] Public [ ]

Rate of Evaporation: = 0.0245 Lbs/Sq. Ft. (See Table Page 3)

0.0245 x 500 Sq. Ft. = 12.25 Lb/hr.

DRY-O-TRON Selection for 12.25 Lb/hr = Model DS 3.5. As per DS 3.5 Performance Curve maximum capacity 15.6 Lb/hr.

Energy Consumption: Rate of Evaporation x* KW/Lb.of Evaporation x Energy Consumption Correction Factor = KW

12.25 Lb/hr x 0.243 x 1.0 = 3.0

Yearly Energy Consumption KW x HR/ANNUM = KWH/ANNUM

3.0 x 8760 = 26,280

Yearly Energy Cost = 26,280 KWH/ANNUM x Cost per KWH.

Above calculation does not include blower motor energy consumption.

*As per DS 3.5 Data sheet 0.243 KW/Lb of evaporation.

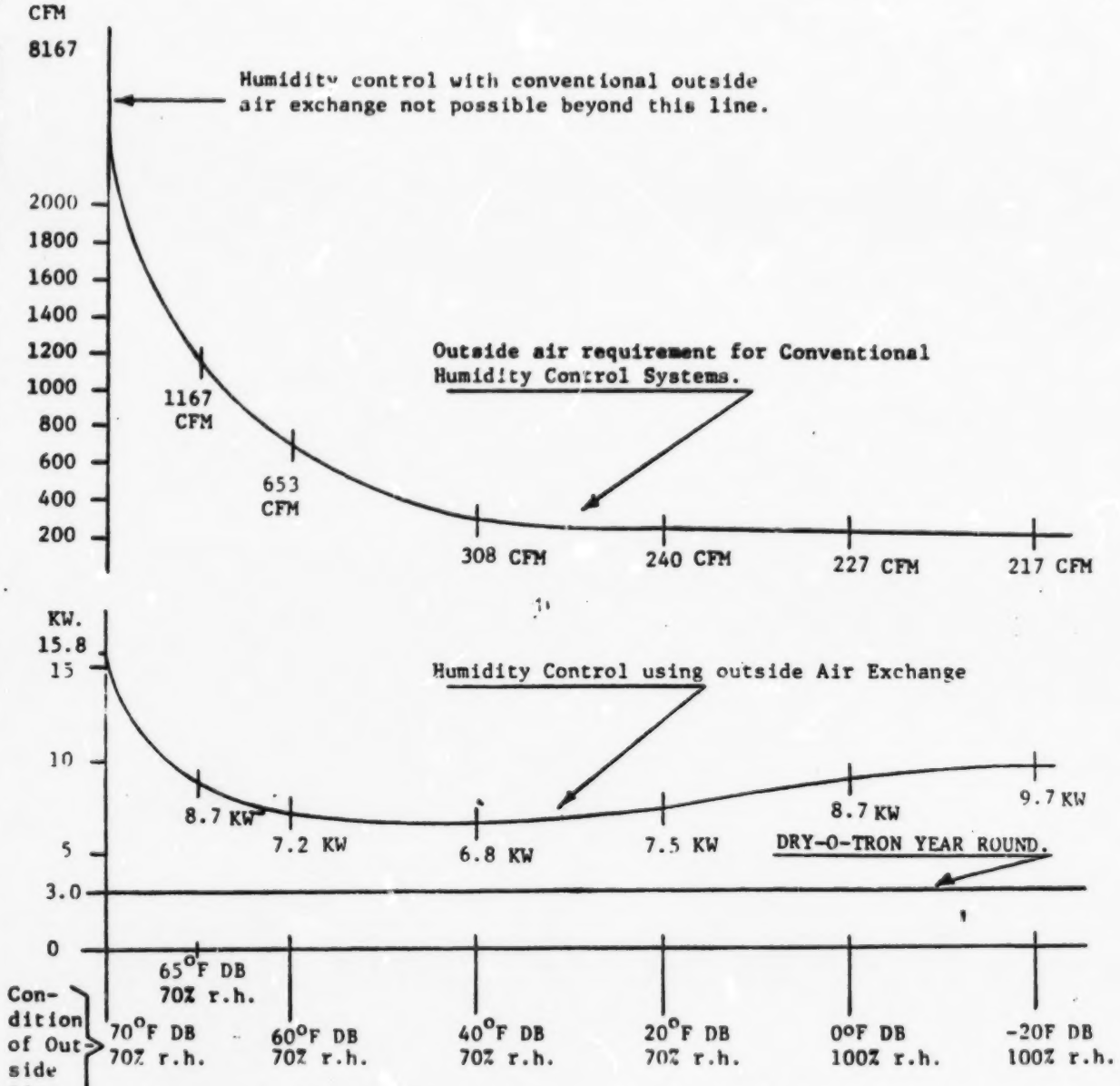
Power Consumption can be reduced by approximately 75% per month during non heating season. See Summer time operation page 28

ENERGY CONSUMPTION CORRECTION FACTOR

	ACTIVE HOURS										
	4	6	8	10	12	14	16	18	20	22	24
	MULTIPLIER										
Private	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Semi-private	.722	.75	.778	.805	.833	.86	.888	.916	.944	.972	1.0
Public	.583	.624	.665	.708	.75	.792	.833	.875	.916	.958	1.0

This factor compensates for evaporation fluctuation due to variation in pool activity.

9. COMPARISON OF ENERGY CONSUMPTION
DRY-O-TRON VERSUS CONVENTIONAL SYSTEMS WITH OUTSIDE AIR EXCHANGE



Comparison is based on Indoor Pool example as outlined on page 5.

NOTE: Infiltration and Transmission heat losses of the pool building are neglected since both systems require the same amount of heat.

All the heat lossed from the pool water due to evaporation is recuperated by the DRY-O-TRON unit and returned into the pool water.
All the electric power consumed by the DRY-O-TRON unit is converted into supplementary heat and transfered into the air.
The dehumidification and pool water heating process therefore is not consuming any energy as long as air heating is required.

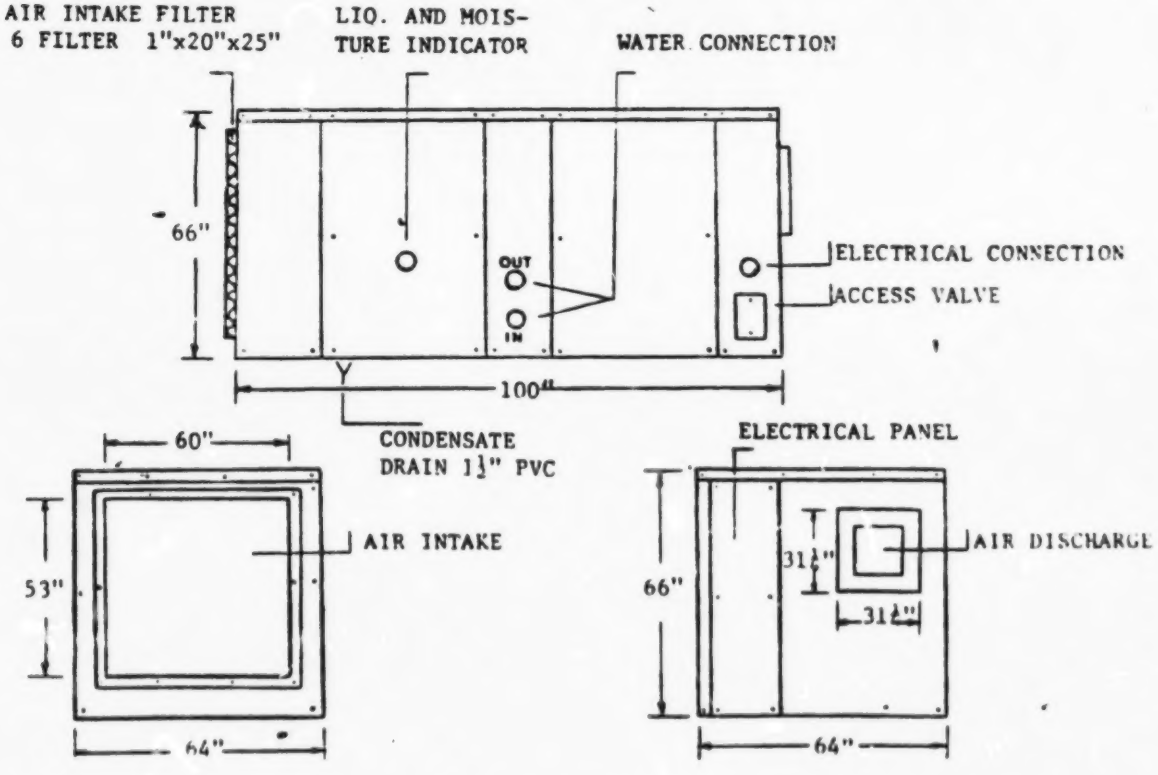
15.03.81

DS 35
R22

MODEL		DS 35-23	DS 35-43	DS 35-53	
VOLTAGE/PH./HZ.		208/3/60	460/3/60	575/3/60	
COMPRESSOR LRA.		565A	283A	226A	
COMPR.	RATED LOAD A.	140A	70A	56A	
	OPERATING A.	89A	44.5A	35.6A	
BLOWER 7.5HP F.L.A.		21.8	9.8	7.9	
DRY-O-TRON * MINIMUM AMPACITY		198	97	78	
TOTAL KW.		28			
CONTROL VOLTAGE		24			
REQUIRED SYSTEM AIR VOLUME IN CFM		13,000	MUST BE BALANCED USING AIR-BY PASS-DAMPER, ADJUS. MOTOR PULLEY & SUPPLY AIR DIFFUSERS WITH VOLUME CONTROL		
EXTERNAL STATIC PRESSURE AVAILABLE IN INCH W.C.		0.5			
C.O.P.		4.3	UNDER STANDARD CONDITION 81°F. AIR TEMPERATURE 80°F. WATER TEMPERATURE 50% R/H.		
KW/Lb. OF EVAPORATION		0.2			
WEIGHT		3250 Lbs.			

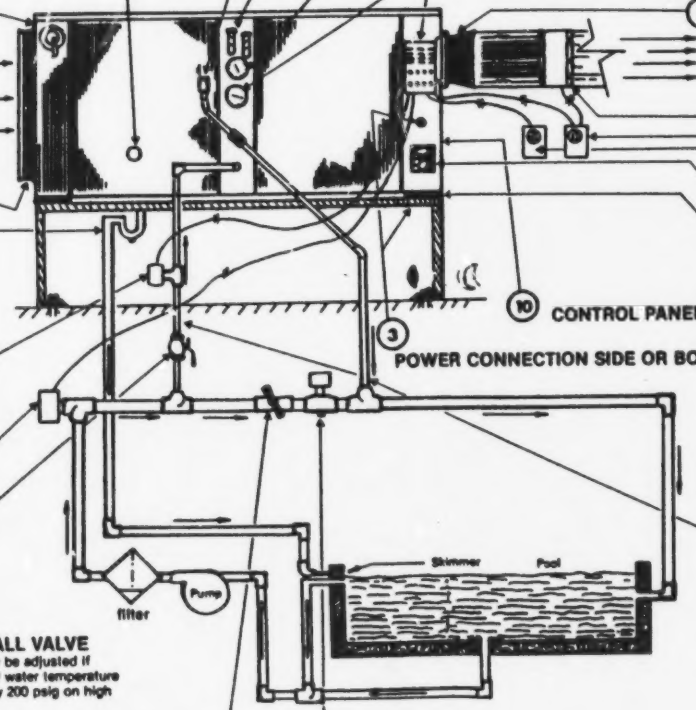
*Ampacity Denotes Electrical Conducter Size required for connection. Check local electrical code.

DIMENSIONS



15.03.81 All dimensions approximate. Certified prints on request.

20 INSTRUCTIONAL DIAGRAM OF DRY-O-TRON



AIR-CONDITIONING (25)
Connection valves for outdoor air cooled condenser. (Optional)

AIR VENT (24)
Must be installed on all high points of plumbing system between DRY-O-TRON and main by-pass valve. Prevents system from being airlocked in minimum water flow condition.

LIQUID AND MOISTURE INDICATOR (23)
Refrigerant indicator should be full without gas bubbles, color dot should indicate dry. After original start-up or after long rest periods bubbles may occur for about 3 minutes. If bubbles continue or moisture is indicated, stop Compressure and call DEALER.

AIR BY-PASS DAMPER (22)
Adjust damper to obtain 60 psig to 65 psig suction pressure. Duct damper adjustments may also be necessary. See (2). Closing damper will increase suction pressure. Opening damper will decrease suction pressure. Damper may have to be closed during start up until pool water has reached operating temperature.

RETURN AIR "AIR IN" (20)
Air stratification must be avoided to prevent coil freeze up.

AIR FILTER (21)
Must be replaced if dirty.

P-TRAP AND CONDENSATE RETURN (19)
Must be installed and filled with water before start up. Prevents air from entering DRY-O-TRON and provides proper drainage for condensate. Condensate should be returned to the pool to substantially reduce water make-up. Failure to install P-Trap will greatly reduce efficiency of dehumidifying capacity. Condensate will remain in drip pan and splash into interior of DRY-O-TRON.
(By installer)

WATER PRESSURE SWITCH (18)
Stops compressor in case of insufficient water flow. Adjust to 3 psig. Prevents refrigerant high pressure switch from shutting off compressor in case of no water flow, must be used if DRY-O-TRON & pool filter are in separate rooms. (Optional)

AQUASTAT (17)
Immersion type pool water thermostat for selecting and adjusting desired pool water temperature. Contact opens on temperature rise. TEE fitting must be one size larger than pipe sizes to accept aquastat

(16) THROTTLING BALL VALVE
For adjustment of maximum water flow. Max. water flow can only be adjusted if aquastat (17) is adjusted to maximum water temperature and pool water temperature is below temperature setting. Maximum water flow is indicated by 200 psig on high pressure gauge. See (1). (By installer)

(15) BY-PASS BALL VALVE
For sliding adjustment of maximum water flow. By-Pass Valve should only be throttled if water flow through DRY-O-TRON is not sufficient. See (16). (By installer)

(14) MOTORIZED WATER VALVE
Must be installed if 2 speed pump is used. Closed on low speed. Open on high speed.
(Optional)

(1) HIGH PRESSURE GAUGE "REFRIGERANT" HEAD PRESSURE
Low Limit 200 psig indicates maximum water heating.
Low Limit must be manually adjusted. See (14) and (15).
High Limit 280 psig indicates minimum water heating.
High Limit is automatically maintained with a built in pressure actuated water valve. Do not run DRY-O-TRON below 180 psi or above 300 psig
180 psig indicates too much water flow, reduce with throttling valve (16). 300 psig indicates no or not enough water flow. Investigate water circulating system and check for air lock.

(2) LOW PRESSURE GAUGE "REFRIGERANT" SUCTION PRESSURE
With proper air volume through DRY-O-TRON suction pressure should be 60 psig to 65 psig.
Below 60 psig increase air volume.
Above 65 psig decrease air volume. See (22)

(4) ELECTRICAL CONTROL CONNECTION
Connect as per wiring diagram supplied with DRY-O-TRON. All connections 24 V.

(5) FLEXIBLE DUCT CONNECTION (By installer)

(7) SUPPLY AIR "AIR OUT"
Duct must be sized to rated air volume.

(6) DUCT HEATER
Can provide complete pool enclosure heating if sized according to building heat loss. Warm dry air should be directed over all window surfaces to avoid condensation during heating season. Heater is supplied with air-flow-switch, high-temperature cut-out and 24 V. supply for thermostat connection. Install as per instructions.
(Optional)

(8) ROOM THERMOSTAT HEATING/COOLING
Controls heating system or optional Duct Heater during heating season. Stops Compressor to prevent pool enclosure over heating. Controls outside Air ventilation system or Air-condition option during summer season. Adjust to original system design room temperature. (Optional)

(9) HUMIDSTAT
Adjust to designed system humidity level. Wall type humidistat may have to be recalibrated after installation with a psychrometer.

(11) REFRIGERANT ACCESS VALVES
For service gauge connection and refrigerant charge. Top valve, head pressure. Bottom valve, suction pressure.

(12) ANTI VIBRATION PADS.
Reduces machine noise. Note: Do not set DRY-O-TRON on plywood sheet, this will amplify machine noise.
(By installer)

(10) CONTROL PANEL

(3) POWER CONNECTION SIDE OR BOTTOM ENTRY

(13) POOL WATER PIPE SIZES
Size of supply and return water pipes must be at least same as connection size on DRY-O-TRON. If pipe connection between DRY-O-TRON and by-pass valve are longer than 10' increase pipe size. Exit pipe (water out) should be PVC rated for 180°F or copper.
(By installer)

DRY-O-TRON
HEAT PUMP, WATER HEATER & DEHUMIDIFIER FOR INDOOR SWIMMING POOLS.
DECTRON INC. MONTREAL CANADA
BURLINGTON VT

APPENDIX "B"

EFFICIENCY OF LIGHT SOURCES

APPENDIX B

EFFICIENCY OF LIGHT SOURCES

LIGHT SOURCE	LAMP WATTAGE	BALLAST WATTAGE	LUMENS	RATED LAMP LIFE	LUMENS/ WATT
Incandescent	300	-	6,000	1,000	20
	500	-	9,900	1,000	20
	1000	-	23,300	1,000	23
Flourescent	40 CW	8	3,150	20,000	65
	40 WW	8	3,200	20,000	66
	75 CW	15	6,300	12,000	70
Mercury	250	35	11,050	24,000	39
	400	50	20,880	24,000	46
Metal Halide	175	40	14,000	7,500	65
	400	50	34,000	15,000	76
High Pressure Sodium	100	16	9,500	20,000	82
	250	53	26,600	24,000	88
	400	75	50,000	24,000	105
Low Pressure Sodium	35	8	4,800	18,000	112
	90	18	13,500	18,000	125
	180	36	33,000	18,000	153

APPENDIX "C"

MONITORING RECORDS

Performance Monitoring Plan

1) Person responsible for Performance Monitoring

Gary Hoadley of Enerplan Consultants co-ordinated the project. Operating personnel at the pool recorded data daily and readings were forwarded weekly to Enerplan.

2) Description of Monitoring Systems

Meters were installed to measure power (Kw) and consumption (Kwh) on the duct heater, lighting, pool heater and heat pump. Elapsed time meters were installed on the pool water pump and on the heat pump.

3) Calculations to be Performed

(a) Calculate difference in Kwh reading for one year.

(b) Assume cost per Kwh is $0.049/Kwh and multiply by difference in (a).

(c) Multiply demand by $7.05/Kw times 12 months/year.

(d) Total costs and calculate difference from before and after retrofit.

(e) Calculate percentage savings.

8157

MIRAMACHI VALLEY
HIGH SCHOOL POOL

ENERGY CONSERVATION DEMONSTRATION PROJECT

ENERPLAN CONSULTANTS LTD.
165 GORDON STREET
MONCTON, N.B.

WEEK COMMENCING 30-1-19 84			MON	TUES	WED	THUR	FRI	SAT	SUN	REMARKS
METER		READING								
NO. 1	DUCT HEATER	KWH	0101	–	–	–	0101			"everything in
		KW DEMAND	0	–	–	–	0			
NO. 2	PUMP P-1	RUN TIME (HRS)	5390.74	5416.39	5439.91	5460.70	5487.74			good Working
NO. 3	LIGHTING	KWH	0152	0154	0155	0159	0156			
		KW DEMAND	60	60	60	60	60			order "
NO. 4	POOL HEATER	KWH	0059	–	–	–	0059			
		KW DEMAND	10	–	–	–	10			A Perfect Setup
NO. 5	HEAT PUMP	KWH	0542	0552	0568	0.591	0671			
		KW DEMAND	300	300	290	290	295			
NO. 6	MAKE UP WATER	GALLONS	–	–	–	–	–			
Machine Time			1893.4	1916.7	1941.4	1964.6	1989.2			
TEMPERATURE OF POOL (°F)			80°	80°	80°	80°	80°			
TEMPERATURE OF AIR (°F)			80°	80°	80°	80°	80°			CAM/3/2/84

8157

MIRAMACHI VALLEY
HIGH SCHOOL POOL

ENERGY CONSERVATION DEMONSTRATION PROJECT

ENERPLAN CONSULTANTS LTD.
165 GORDON STREET
MONCTON, N.B.

METER		READING	WEEK COMMENCING 13-2-1984 MON	TUES	WED	THUR	FRI	SAT	SUN	REMARKS
NO. 1	DUCT HEATER	KWH	0101	—	—	—	0101			Everything
		KW DEMAND	0	—	—	—	0			working O.K.
NO. 2	PUMP P-1	RUN TIME (HRS)	5727.67	5752.83	5778.27	5801.25	5823.55			EBM.
NO. 3	LIGHTING	KWH	0163	0164	0164	0165	0166			
		KW DEMAND	60	60	60	60	60			
NO. 4	POOL HEATER	KWH	0059	—	—	—	0059			
		KW DEMAND	10	—	—	—	10			—
NO. 5	HEAT PUMP	KWH	0647	0648	0649	0648	0654			
		KW DEMAND	300	300	300	290	300			
NO. 6	MAKE UP WATER	GALLONS	—	—	—	—	—			
Machine Time			2206.7	2232.3	2257.7	2285.0	2297.4			—
TEMPERATURE OF POOL (°F)			82°	82°	82°	82°	82°			
TEMPERATURE OF AIR (°F)			82°	82°	82°	82°	82°			EBM/17/2/84

METERING PLAN

NOTES

1. 200A, 600V. 2 ELEMENT SOCKET TYPE ENERGY AND DEMAND METER AND METER SOCKET, INSTALLED IN EXISTING FEEDER

2. 50A, 600V, 2 ELEMEMT SOCKET TYPE ENERGY AND DEMAND METER AND METER SOCKET, INSTALLED IN EXISTING FEEDER

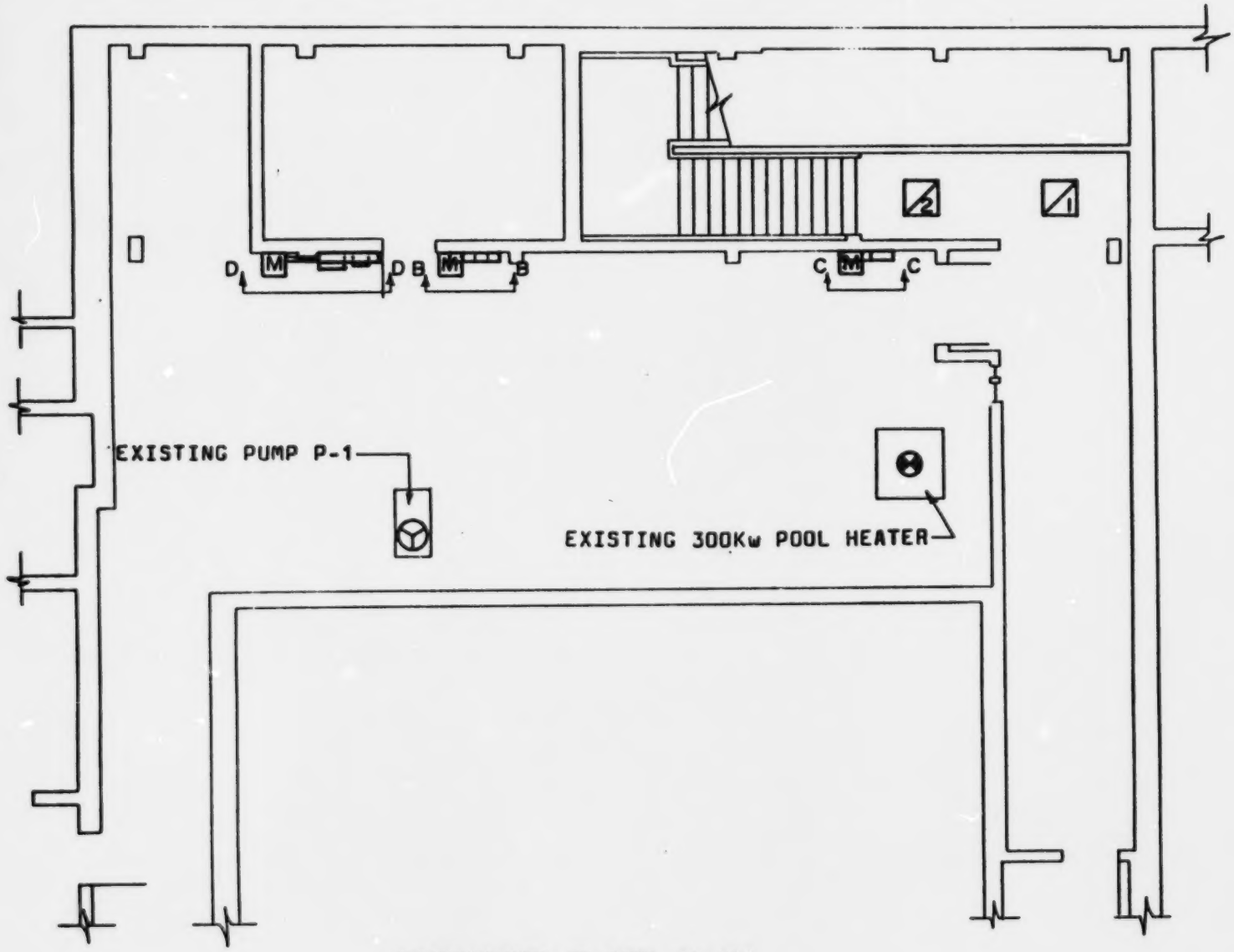
3. .12-8A, 120V, 2 ELEMENT P BASE TYPE ENERGY AND DEMAND METER IN METER CABINET.

4. 2-300/5A CT'S AND 2-600/120V PT'S IN 20" x 30" INSTRUMENT CABINET

5. HOUR METER IN 4x4x6" BOX AS PER SPEC CONNECTED TO PUMP CONTROL CIRCUIT THROUGH N/O AUXILLIARY CONTACT.

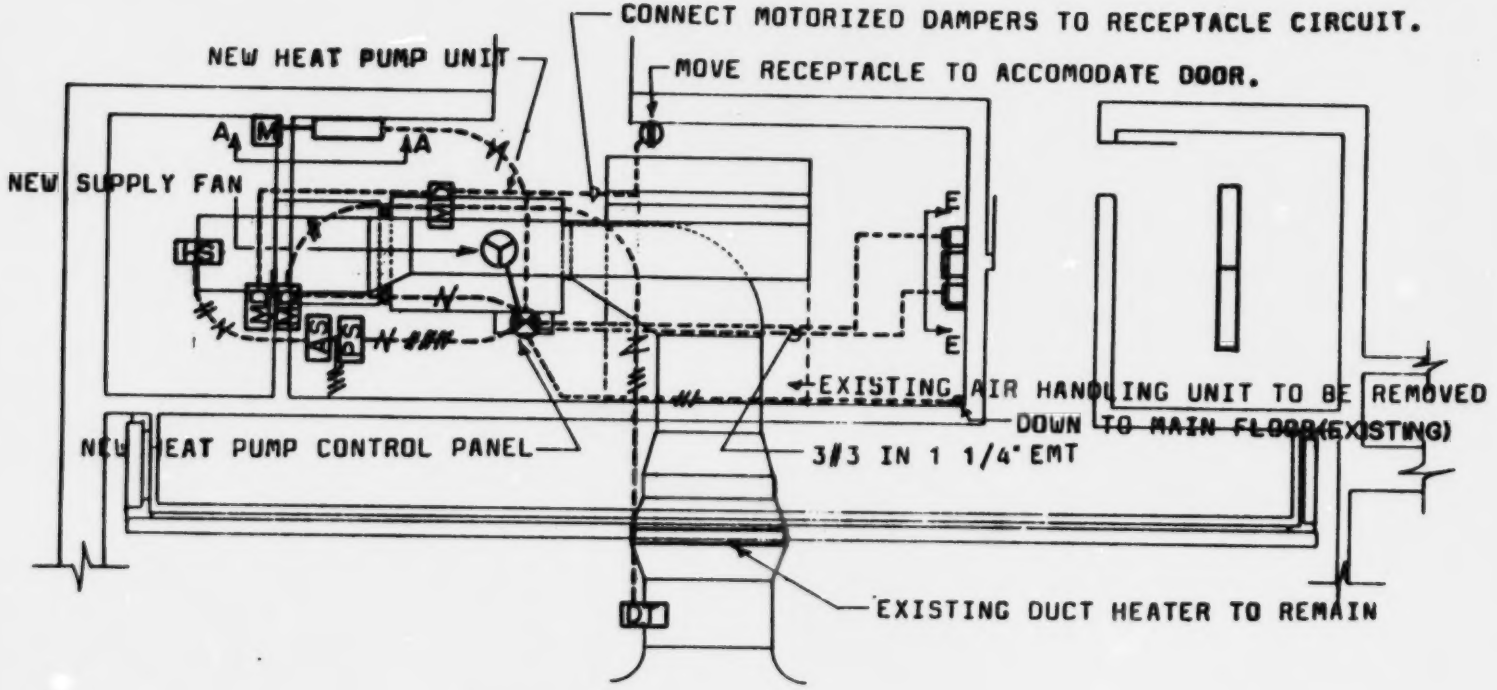
6. 100A, 600V, 2 ELEMENT SOCKET TYPE ENERGY AND DEMAND METER AND METER DEMAND METER AND METER SOCKET.

7. SHADING OF LAYOUTS INDICATES NEW EQUIPMENT



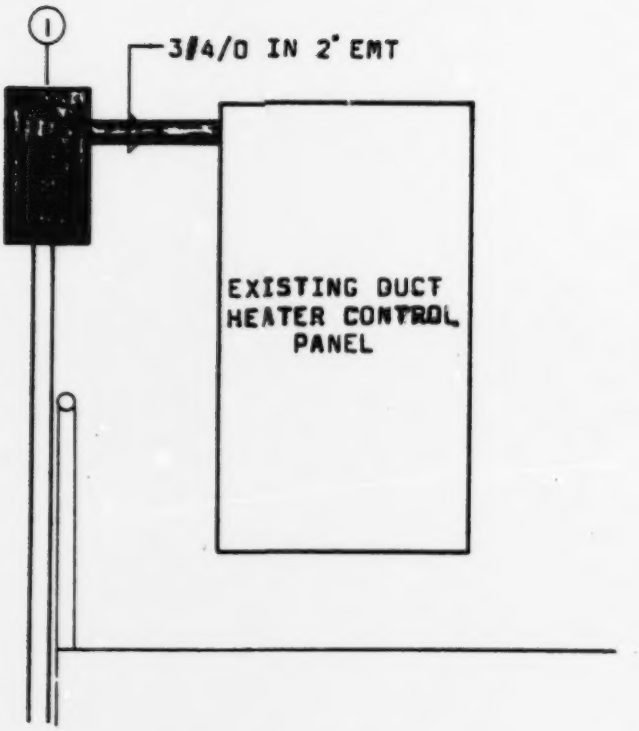
BASEMENT FLOOR PLAN

SCALE 1/8"=1'-0"


CONNECT MOTORIZED DAMPERS TO RECEPTACLE CIRCUIT.
NEW HEAT PUMP UNIT
MOVE RECEPTACLE TO ACCOMODATE DOOR.
NEW SUPPLY FAN
EXISTING AIR HANDLING UNIT TO BE REMOVED
DOWN TO MAIN FLOOR(EXISTING)
NEW HEAT PUMP CONTROL PANEL
3#3 IN 1 1/4" EMT
EXISTING DUCT HEATER TO REMAIN

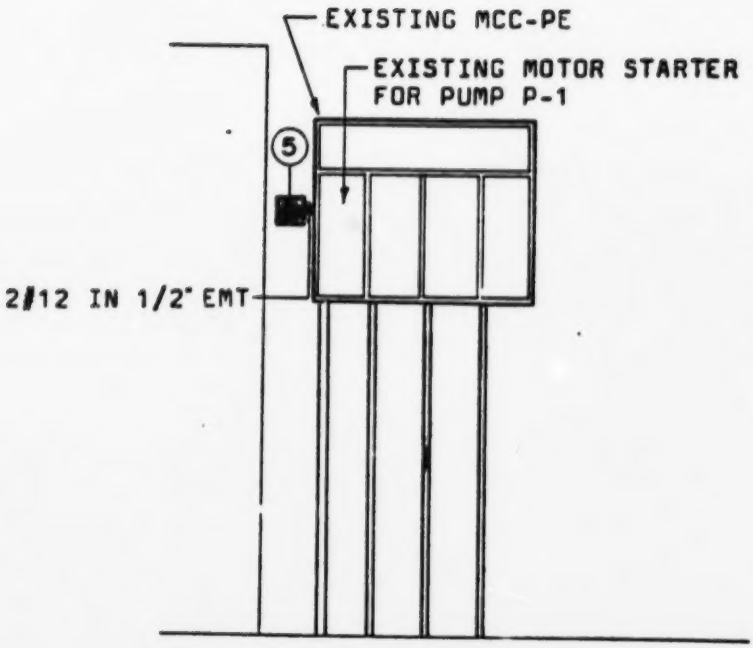
SECOND FLOOR PLAN

SCALE 1/8"=1'-0"



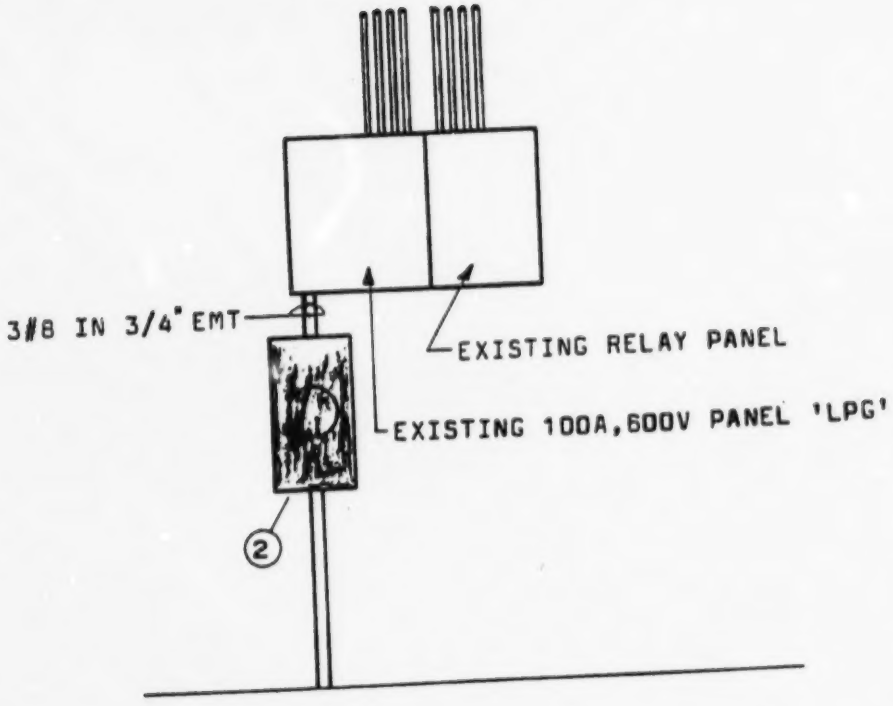
DUCT HEATER METERING LAYOUT (A)

SCALE 1/2" = 1'-0"



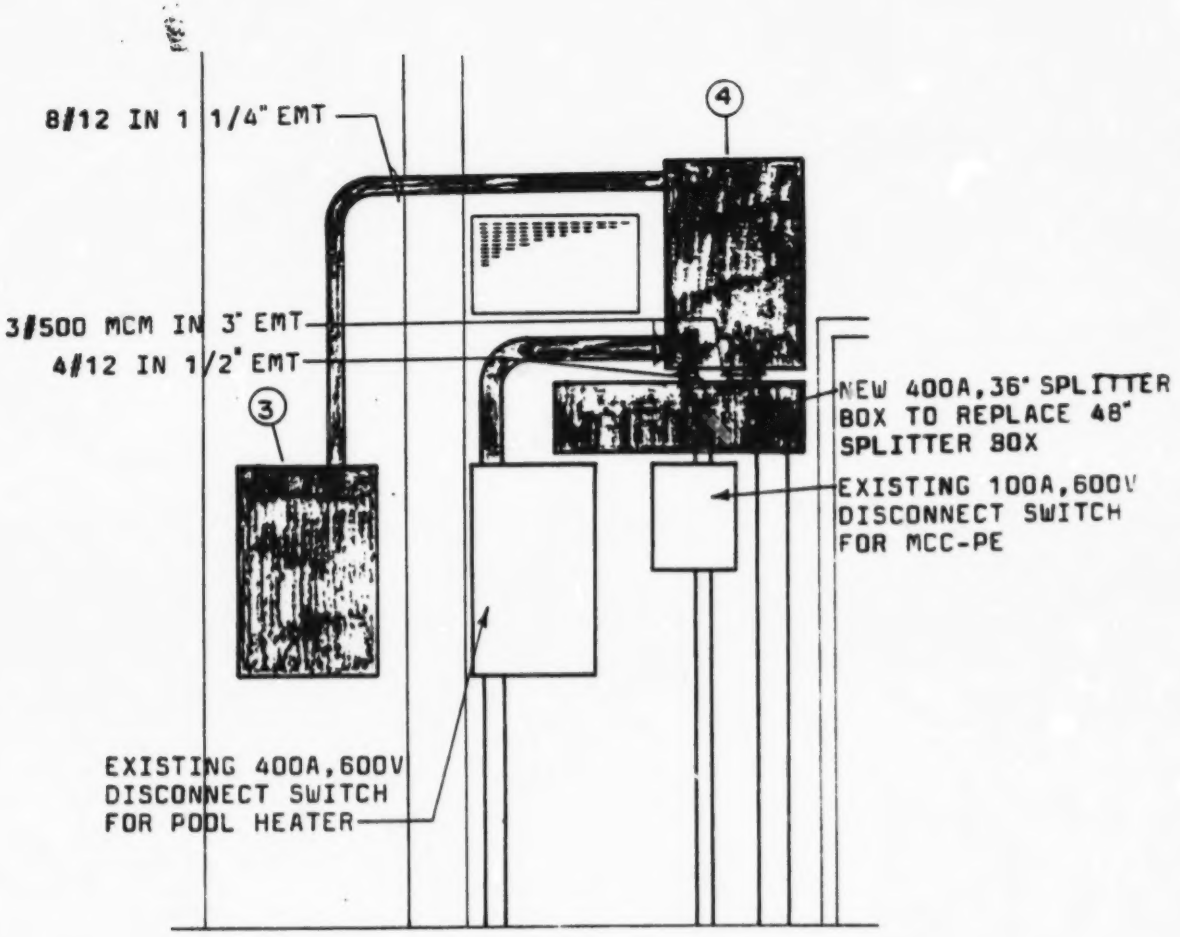
PUMP P-1 METERING LAYOUT (B)

SCALE 1/2"=1'-0"



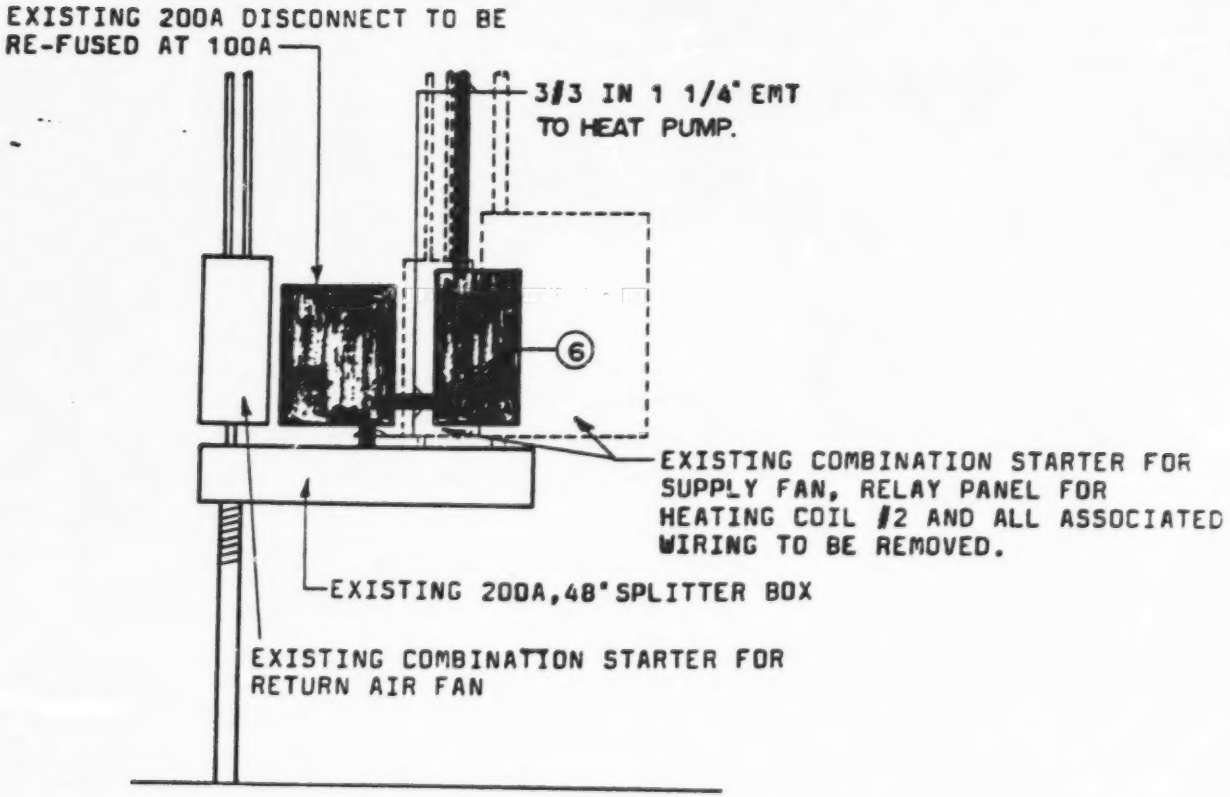
PANEL 'LPG' METERING LAYOUT (C)

SCALE 1/2"=1'-0"


8#12 IN 1 1/4" EMT
4
3#500 MCM IN 3" EMT
4#12 IN 1/2" EMT
3
NEW 400A,36" SPLITTER BOX TO REPLACE 48" SPLITTER BOX
EXISTING 100A,600V DISCONNECT SWITCH FOR MCC-PE
EXISTING 400A,600V DISCONNECT SWITCH FOR POOL HEATER

POOL HEATER METERING LAYOUT (D)

SCALE 1/2"=1'-0"


EXISTING 200A DISCONNECT TO BE RE-FUSED AT 100A
3/3 IN 1 1/4" EMT TO HEAT PUMP.
6
EXISTING COMBINATION STARTER FOR SUPPLY FAN, RELAY PANEL FOR HEATING COIL #2 AND ALL ASSOCIATED WIRING TO BE REMOVED.
EXISTING 200A,48" SPLITTER BOX
EXISTING COMBINATION STARTER FOR RETURN AIR FAN

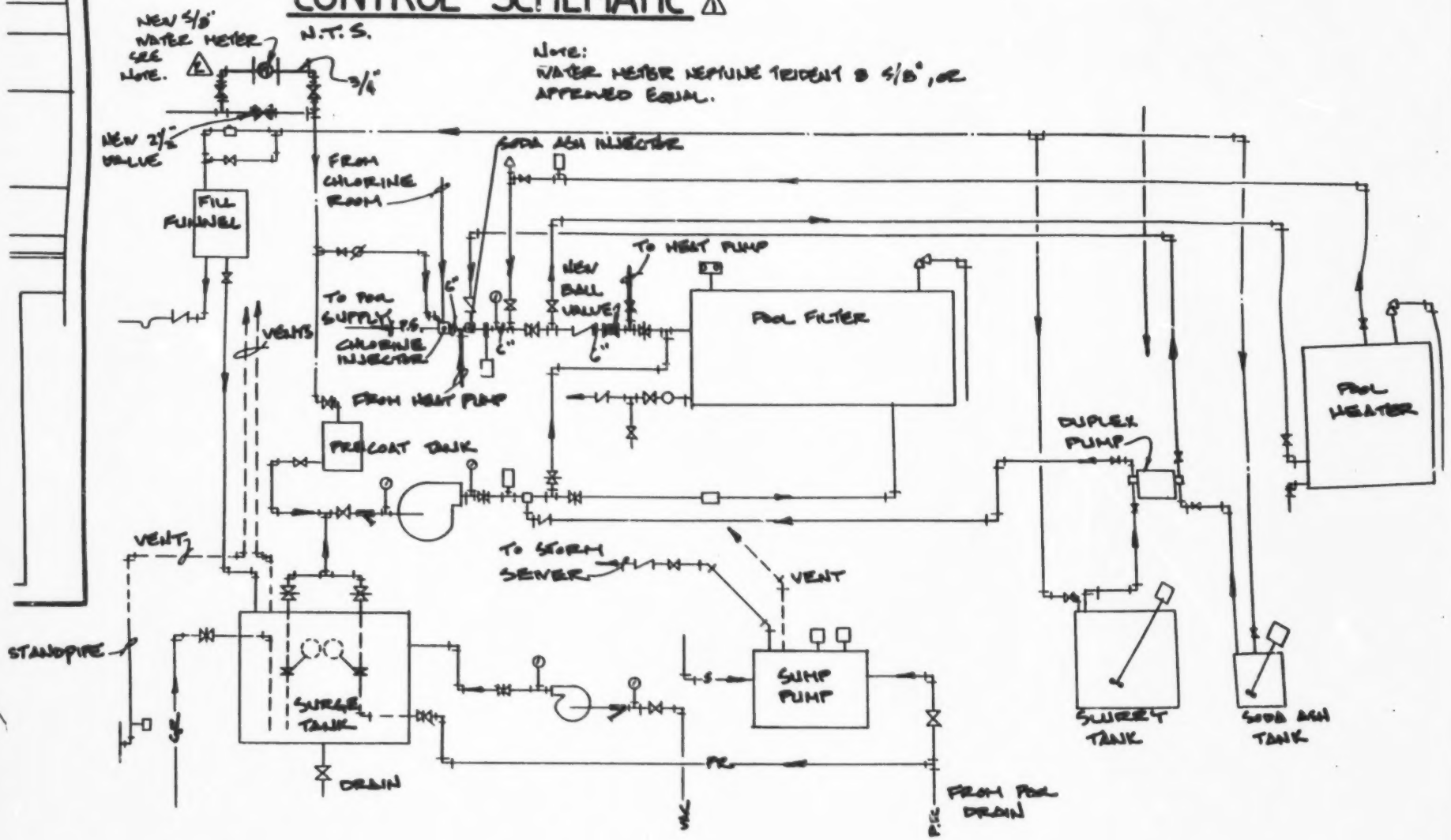
HEAT PUMP METERING LAYOUT (E)

SCALE 1/2"=1'-0"

CONTROL SCHEMATIC ⚠

N.T.S.

NOTE:
WATER HEATER NEPTUNE TRIDENT @ 5/8", OR APPROVED EQUAL.



POOL EQUIPMENT & PIPING SCHEMATIC ⚠

N.T.S.

APPENDIX "D"

LIGHTING COST BENEFIT ANALYSIS DETAILS

Lighting Analysis

(1) Assume lights are on for 5100 hours per year.

Previous Lighting

20 at (400 watts = 80 watts ballast) = 9600

Total hours per year 5100 hours

Consumption = 48960 Kwh

since lighting is part of a larger complex cost per Kwh is $0.049/Kwh

48960 Kwh x $0.049 = $2399.04

demand at $7.05/kw/month is:

9.6 x $7.05 x 12 = 812.16

$3211.20

Present Lighting

18 at (250 + 60) = 2 at (400 + 50) = 6480 watts

Consumption = 6.48 x 5100 = 33048 Kwh

33048 Kwh x $0.049/Kwh = $1619.352

6.48 Kw x 12 x $7.05 = $ 548.208

$2167.56

(2) Actual Consumption Cost $1600 of which $548 is demand.
Consumption therefore cost $1052 per year.
Scale calculation for previous lighting based on present actual consumption

$$\frac{(1052)}{(1619)} \quad (2399.04) = 1558.85$$

Therefore previous cost = 1558.85 + 812.16 = $2371

present cost = 1600

$ 770 say $800/year